Name _____

"Pop Beadase" Enzyme Simulation

Introduction:

Biologists are very interested in *enzymes* - special proteins (also called *catalysts)* that help chemical reactions take place inside organisms. A living organism is a biological system that depends on *thousands* of chemical reactions taking place at just the right time. Without enzymes, most biochemical reactions would happen very slowly or not at all. This would be very BAD for all living things!!!

Enzymes lower the *activation energy* required to start a chemical reaction. Enzymes are specific for each reaction and are reusable. Enzymes have an area called the *active site* to which a specific molecule, called the *substrate*, binds to temporarily while the reaction is taking place. In this activity, you will model enzyme activity under the following conditions: normal/baseline conditions, presence of a coenzyme, partial denaturation of the enzyme, and with competitive inhibition.

Procedure:

In this activity, you will simulate the role of the enzyme *pop beadase* in a reaction involving the conversion of individual pop bead monomers to a polymer chain of the connected beads.

1. You will work in groups of three to four people. Assign one of the following roles to each person in your group. The assigned person needs to perform the same role for the entire simulation. (Note: If you only have 3 people in your group, then one person can perform both Role #3 and #4.)

   Role #1 - Bead Collector: Collect and pops the beads together _____

   Role #2 - Timer: Keeps time for the group _____

   Role #3 - Counter: Counts total number of beads at given time intervals _____

   Role #4 – Recorder: Records the data for the group _____

2. Each group will do a **baseline simulation** for their **first trial** using the following method:

   A. The bead collector will travel (walk) back and forth from the work station to the tub of pop beads in the middle of the room. Each time the bead collector goes to the tub, he/she will pick up the **assigned color** of pop bead, then return to the work station to attach it onto a growing chain of pop beads.
   B. The timer will start the stopwatch at the beginning of the simulation and will shout out ten-second intervals to the counter. The timer will do this from 0 to 120 seconds (2 minutes).
   C. The counter will keep track of how many beads are in the growing pop bead chain and each time the timer shouts out a ten second time interval, the recorder will write down the **total number** of beads linked together in Table 1.

3. After the baseline simulation is complete, each group will do three variations as indicated below:

   A. **Trial 2: Role of coenzyme (cofactor)**
   After the bead collector grabs a bead, he/she will no longer be required to attach the bead to the growing chain. Instead, he/she will hand off the bead to the counter, who will attach it to the growing chain while the bead collector heads back to get yet another bead. The counter still needs to keep track of total number of beads. (In a group of 3, the timer will record the number in the data table.)

   B. **Trial 3: Partial denaturation of enzyme**
   The bead collector will place (clean!) socks on their hands. The bead collector will then collect beads in the same fashion as the baseline simulation by transporting one bead at a time to their work station and attaching it to their growing chain themselves. The timer, counter, and recorder have the same roles as in the baseline trail.

   C. **Trial 4: Competitive Inhibition**
   The bead collector has to bounce and catch a ping pong ball before collecting each bead and then returning to the work station to pop them together. All other roles are the same as the baseline activity.

4. Create a **line graph** that includes **all four** of your trials on the same set of axes. Make sure to title your graph, label your axes (with units!), and create a specific key for your trials.

Data:

Table 1

Time (s)	Trial 1: Baseline/Normal	Trial 2: Coenzyme	Trial 3: Denaturation	Trial 4: Comp. Inhibition
0				
10				
20				
30				
40				
50				
60				
70				
80				
90				
100				
110				
120				

Conclusion:

After graphing your four trials, use your data to help you write your conclusion in **paragraph formation** (may be several paragraphs long**).** In your conclusion make sure to **use complete sentences** to summarize what you did and your results. Explain what you learned about enzymes and reaction rates. Be sure to use science vocabulary in your explanation (ie-don't just talk about beads and people but explain what they have to do with chemical reactions). Be sure to include the following:

- In the simulation, explain what represented EACH of the following
    - Substrate, Enzyme, Active site, Coenzyme, Inhibitor
- Explain how our enzyme was partially denatured in the simulation AND explain examples of different kinds of factors that could realistically denature an enzyme
- Explain which factors sped up the reaction rate vs which ones slowed it down and WHY
- Explain how the reaction rates could be altered if more of your substrates were present
- Explain how the reaction rates could be altered if more enzymes were added to your group